production. The latter occurs by resorption and replacement of dead trabeculae and appositional growth around dead trabeculae.

Although there is an immune response to transplanted allograft bone, immunosuppressive drugs are not used to neutralize the reaction because of their serious side effects. Graft immunogenicity may be reduced by freezing the allograft before transplantation and forcefully lavaging the allograft bone to remove the fat cells and hematopoietic elements that provoke an immune response in a patient.

Treatment of cartilage allografts with dimethyl sulfoxide and 10% glycerine before freezing has been reported to maintain viability of about 50% of donor chondrocytes. There is a question, however, as to the capacity of these cells to produce collagen and mucopolysaccharides after thawing and transplantation.

More recently there have been reports of the successful resurfacing of portions of synovial joints in the lower extremities with fresh nonfrozen composite graft of hyaline cartilage and bone. The bone portion provokes a clinically insignificant immune response. The cartilage of the graft is thought to be "immunologically privileged" because the matrix prevents the diffusion of large molecules of antigens and antibodies. Because of this, the afferent and efferent arms of the immune reaction cannot interact and produce a rejection response.

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REFERENCES

Gross AE, Silverstein EA, Folk J, et al: The allotransplantation of partial joints in the treatment of osteoarthritis of the knee. Clin Orthop 1975; 108:7-14

Harris WH, Crothers O, Oh I: Total hip replacement and femoral-head bone-grafting for severe acetabular deficiency in adults. J Bone Joint Surg [Am] 1977 Sep; 59:752-759

Meyers MH: Resurfacing of the femoral head with fresh osteochondral allografts. Clin Orthop 1985 Jul-Aug; 197:111-114

Parrish FF: Treatment of bone tumors by total excision and replacement with massive autologous and homologous grafts. J Bone Joint Surg [Am] 1973; 55:1-22

Endoprosthetic Limb Salvage Operation for Malignant Bone Tumors

THE HISTORICAL APPROACH to the local control of primary malignant bone tumors, including osteosarcoma, chondrosarcoma, fibrosarcoma, malignant fibrohistiocytoma and, in certain instances, Ewing's sarcoma, has been amputation. Recent advances in surgical resection techniques, muscle transfers and improved mechanical design of custom endoprostheses have established the limb-sparing operation as a possible alternative for local control of malignant bone tumors when coupled with preoperative adjuvant therapy.

Two basic goals must be achieved by a limb-sparing operation for malignant bone tumors. The local recurrence rate in a salvaged extremity should be no higher than that achieved with amputation, and the reconstructed extremity should be enduring and functional, without requiring repetitive hospital admissions for the management of local complications or complex revisional procedures.

The functional results of endoprosthetic reconstruction following wide resection for malignant bone tumors have been excellent about the knee and good to excellent at the hip. Scapular and proximal humeral replacements permit normal hand and elbow function and avoid the need for orthoses and cumbersome prostheses. For pelvic lesions, an internal hemipelviectomy, when feasible, retains the extremity and results in an extremity with good cosmetic appearance and moderate function. Neurovascular gastrocnemius muscle transfers permit endoprosthetic replacement of the proximal tibia with the anticipation of reasonable extensor function of the knee. Expandable prostheses make limb salvage for a very young patient, especially with Ewing's sarcoma, feasible.

Preoperative chemotherapy and radiation therapy have decreased the local recurrence rate after a limb-sparing operation to 5%, not statistically different from the local recurrence rates seen following amputation. In the absence of preoperative adjuvant chemotherapy, the reported local recurrence rates range between 20% and 60%.

In summary, limb-sparing surgical techniques using improved custom endoprostheses with preoperative adjuvant chemotherapy now permit a limb-sparing operation in most patients presenting with primary malignant bone tumors. Amputation for the primary control of malignant bone tumors continues to be indicated for those patients who present with very large tumors, those with incorrectly placed or infected biopsy incisions and patients who present with tumors of the distal tibia or the foot.

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REFERENCES

Eckardt JJ, Eilber FR, Dorey FJ, et al: The UCLA experience in limb salvage surgery for malignant tumors. Orthopedics 1985; 8:612-621

Eilber FR, Eckardt JJ, Morton DL: Advances in the treatment of sarcomas of the extremity: Current status of limb salvage. Cancer 1985 Dec; 54:2695-2701